ECE 322L - Lab 2

Goal

In this lab you will gain understanding of nmos transistor regions of operation, analyzing the IV characteristic curves, gain experience modeling using PSPICE, MultiSim, or your preferred simulation software, and verify your hand analysis of the circuit.

Equipment needed

- ❑ Lab notebook, pencil
- ❑ Agilent Digital Multimeter
- ❑ AgilentVariable Power Supply
- ❑ BNC/EZ Hook test lead
- ❑ Banana Clips

Parts needed

- ❑ Circuit breadboard
- ❑ Lab parts kit
- ❑ Transistor, N-MOS, BS170
- ❑ Jumper wires
- ❑ Resistors: 1KΩ, 6.2kΩ, 0.5 kΩ
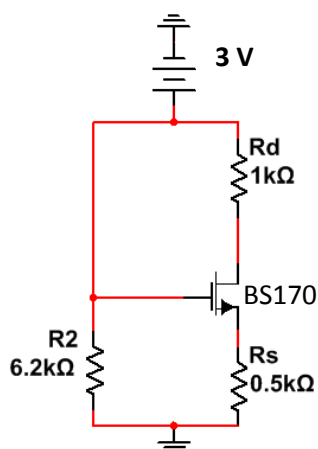
Software needed

- ❑ PSpice or MultiSim

The Lab

Fig1: Circuit Diagram

Part 1

- Perform hand analysis of the given circuit (Figure 1). Use the values K'$_n$ = 1.825 mA/v^2, (W/L) = 1 and V$_{TN}$=1 in your hand calculations.
- What region of operation (Cut-off/Saturation/Linear) is the device in?
- Construct the circuit using BS170 NMOS transistor and given resistor values. Test the circuit at varying V$_{DD}$ and graph I$_D$ vs V$_{DD}$.
- Include a sketch of the load line in your report.
- Simulate the circuit using your preferred software.
- Compare the results between your hand calculations, model, and measurements
  - Be sure to list I$_{DQ}$,V$_{DSQ}$, and V$_{GSQ}$ at the given V$_{DD}$.
  - What could be the cause of differences in the three different measurements?

Part 2

- How could we change the operating region of the transistor? Develop a hypothesis, and then perform hand calculations to verify it.
- Provide a circuit diagram of your modified circuit
  - Include your calculations for I$_{DQ}$, V$_{DSQ}$ and V$_{GSQ}$ at a specific V$_{DD}$. Plot the load line and Q-point for your chosen V$_{DD}$.

Extra Credit

- Build the modified circuit,
  - Make sure the device parameters can handle the new currents and voltages.
- Test the circuits I$_{DD}$ with varying V$_{DD}$. Graph the results.
- Make a table comparing the measured values against the hand calculations for I$_{DQ}$,V$_{DSQ}$ and V$_{GSQ}$ at a specific V$_{DD}$.

Note: Please only include the Pspice code you used, and applicable output values in your report. You do not need to copy the entire output file into your report. Make sure to include a circuit diagram with the nodes you used in your code labeled. For MultiSim, please provide screen captures of the measurements.

Clean your lab space

After you have finished the lab, put away all materials you were using in the proper places. Make sure the lab area is clean. **Failure to follow proper lab etiquette will result in deductions on your lab report grade.**

Lab 2 Rubric	
Requirement:	Possible Points (100)

Part 1:
   a. Hand Calculations and Region of Operation (20 points)
   b. Graph of I_D Vs. V_{DD} (20 points)
   c. Load line and Q-point Sketch (15 points)
   d. Compare and explain difference between hand/measured/simulated results (20 points)
	75

Part 2:
   a. Hypothesis and hand calculations (10 points)
   b. Quiescent Values (5 points)
   c. Load line with Q-point (10 points)
	25

Extra Credit
   a. Graph of I_D Vs. V_{DD} (5 points)
   b. Table comparison of measured and hand calculations quiescent values (5 points)
	10 extra